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CLAIMS

[Claim(s)]

[Claim 1] The variant cross-section double taper spring steel line characterized by having the taper section of tapering off of a similarity cross section mostly with this straight section in the ends side of the straight section of a variant cross section.

[Claim 2] The strand for variant cross-section double taper spring steel lines characterized by being the strand with which the taper section of a similarity cross section consists in the length orientation by turns mostly with the straight section of a variant cross section, and this straight section.

[Claim 3] The manufacture technique of the variant cross-section double taper spring steel line characterized by heating a processed steel wire to rolling temperature by IH or/, and the direct energization heating means, and fabricating the taper section of tapering off of a similarity cross section mostly by the hot forming with the straight section of a predetermined variant cross section, and this straight section by the side of the ends.

[Claim 4] The manufacture technique of the variant cross-section double taper spring steel stroke line characterized by fabricating the strand in which a processed steel wire is heated to rolling temperature by IH or/, and the direct energization heating means, and the taper section of a similarity cross section consists by turns mostly with the straight section of a predetermined variant cross section, and this straight section by the hot forming.

[Claim 5] The hot forming of the aforementioned variant cross section is the manufacture technique of the variant cross-section double taper spring steel line according to claim 3 or 4 characterized by the reduction roll by which an opposite roll spacing is controlled according to a necessary cross section rolling out, or its strand.

[Claim 6] The aforementioned variant cross-section double taper spring steel line is the manufacture technique of the variant cross-section double taper spring steel line according to claim 5 characterized by being a rectangle or an approximation trapezium cross section, or its strand.

[Claim 7] The manufacture technique of a variant cross-section double taper spring steel line given in either of the claims 3-6 characterized by quenching immediately after the aforementioned hot forming and performing manipulation hardening, or its strand.

[Claim 8] The manufacture technique of the variant cross-section double taper spring steel line according to claim 7 characterized by annealing with IH succeeding the aforementioned manipulation hardening back, or its strand.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention is the spring steel wire coiled around a barrel shape or a spindle shape coiled spring configuration, and relates to the double taper spring steel line of a variant cross section by which a cross section has the tapering taper section in both the nose of cams side of the uniform straight section, and its manufacture technique.

[0002]

[Description of the Prior Art] usual coiled spring makes the diameter of a strand of the coil minor-diameter section 16 by the side of a spring edge smaller than the diameter of a strand of the coil drum section 15 of a spring, as it shows the strand of the diameter of the same in drawing 5 in the case of a barrel shape or spindle shape coiled spring, although an overall length winds and is fabricated — it is desirable When it carries out like this, as compared with the barrel-shape spring of the diameter strand of the same, a special spring property can all be acquired, and there is an advantage that weight mitigation can be performed. For that purpose, ends are expected to use the double taper steel wire which has the tapering taper section as a spring steel wire.

[0003] On the other hand, although the spring steel line of not a round-head cross section but a variant cross section is used for lightweight-izing and the enhancement in a spring property in usual coiled spring, also in a barrel shape or spindle shape coiled spring, use of a variant cross-section spring steel line is desired. For this reason, the double taper spring steel line of a variant cross section is demanded.

[0004] About the manufacture technique of such a double taper spring steel line, there is technique which the applicant indicated about the double taper spring steel line of a round-head cross section in JP,11-169991,A previously.

[0005]

[Problem(s) to be Solved by the Invention] However, a double taper steel wire given [aforementioned] in JP,11-169991,A is indicated about the steel wire of a round-head cross section, and the double taper spring steel line of a variant cross section does not yet exist in a commercial scene today, either, being wished.

[0006] Moreover, the conventional variant cross-section spring steel line was manufactured at the wire-drawing process which carries out the wire drawing of the rolled steel of a round-head cross-section-to-a-variant-cross-section, and 2 of a heat treatment process processes which carry out a quenching and tempering by technique, such as an oil temper, after that. Therefore, there are many processes, the man day increased and there was a trouble where a cost reduction was difficult.

[0007] Then, this invention solves the above-mentioned trouble and aims at offering the double taper spring steel line and its cheap manufacture technique of a variant cross section.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the variant cross-section double taper spring steel line of this invention is characterized by having the taper section of tapering off of a similarity cross section mostly with this straight section in the ends side of the straight section of a variant cross section.

[0009] Moreover, it is characterized by the strand for the variant cross-section double taper spring steel lines of this invention being a strand with which the taper section of a similarity cross section consists in the length orientation by turns mostly with the straight section of a variant cross section, and this straight section. By cutting suitably the strand with which such straight section and the taper section consist by turns, mass production of a variant cross-section double taper spring steel line which has the tapering taper section to the ends of the aforementioned straight section is made easily.

[0010] The manufacture technique of the variant cross-section double taper spring steel line of this invention, and a strand A processed steel wire is heated to rolling temperature by IH or/, and the direct energization heating means. [whether the taper section of tapering off of a similarity cross section is mostly fabricated by the hot forming with the straight section of a predetermined variant cross section, and this straight section by the side of the ends, and] Or it is characterized by fabricating the strand in which the taper section of a similarity cross section consists by turns mostly with the straight section of a predetermined variant cross section, and this straight section by the hot forming.

[0011] The hot forming of the aforementioned variant cross section is desirable in order that it may attain the purpose simply that the reduction roll by which an opposite roll spacing is controlled according to a necessary cross section rolls out.

[0012] That is, using the reduction roll by which a computer opens, it narrows or the spacing of an opposite roll is controlled in connection with advance of rolling, the straight section fixes a roll spacing and rolls it out, and the taper section fabricates a taper by advancing rolling, extending a roll spacing with slight straitness. With a rolling configuration, the multi-direction roll of a two way roll, the methods of three, or a four way roll may be used, and, as for this reduction roll, the number of roll stands may also arrange one stand or two or more stands to a tandem.

[0013] Although this variant cross-section double taper spring steel line is suitable for a rectangle or an approximation trapezium cross section, a variant cross section here includes configurations other than circles, such as a square, a rectangle, a polygon, and an ellipse. Moreover, the thing containing the approximation cross section of the taper section to which a similarity cross section is continuously connected with the straight section, and not only full similarity but the straight section is said mostly.

[0014] Moreover, molding and hardening heat treatment of a variant cross section are attained at one process by quenching immediately after the aforementioned hot forming and performing manipulation hardening. If the hardening cooling means which approaches the aforementioned reduction roll and was arranged in the tandem is made to perform this manipulation hardening, the quenching from rolling temperature will become uniform and high hardening hardness will be obtained easily. And the effect of manipulation hardening with them is acquired by carrying out rapid short-time heating with IH etc. [there are few defects, such as decarbonization, and higher than usual kiln heating]

[0015] Furthermore, molding of a variant cross section and a quenching and tempering are made by the continuous process by annealing with IH succeeding the aforementioned manipulation hardening back. It is desirable to perform this annealing continuously with the tempering IH coil arranged by the tandem behind the aforementioned hardening cooling means.

[0016]

[Embodiments of the Invention] Hereafter, 1 operation gestalt of illustration of this invention is explained concretely. Drawing showing [1] an example of the variant cross-section double taper spring steel line and strand (only henceforth double taper steel wire) of this invention example, the conceptual diagram showing [2] the configuration of the whole manufacturing installation of the double taper steel wire of this invention example, and the drawing 3 are drawings showing an example of the four way roll which rolls out the spring steel line of an approximation trapezium cross section.

[0017] As shown in drawing 1, double taper steel-wire S of this invention makes the configuration of length L where the taper sections 12 and 13 of tapering off of an

approximation cross-section configuration were mostly formed in the ends side of the straight section 11 with the same cross-section dimension of a variant cross section. Although you may fabricate this at a time independently 1 **, as shown in drawing 1, the straight section 11 and the taper sections 12 and 13 fabricate the strand formed by turns, and the mass production of double taper steel-wire S of length L becomes easy by cutting in the position 14 of the diameter of the minimum.

[0018] If the manufacturing installation of drawing 2 is explained, the IH coil 6, the reduction roll 7, the water cooled jacket (hardening cooling means) 8, and the tempering IH coil 9 are arranged by the tandem from the upstream side.

[0019] An approximation trapezium cross section which shows the cross-section configuration rolled out in the drawing 3 besides a square and a rectangle is fabricated. Although drawing 3 shows the configuration of the four way roll which rolls out the steel wire of an approximation trapezium cross section, it fabricates the trapezoid side face with the level rolls 1 and 1 of one pair of upper and lower sides, and is made to have the trapezoid top base fabricated by the vertical rolls 2 and 2 of one pair of right and left. By computer 5, the drive control of the level rolls 1 and 1 and the vertical rolls 2 and 2 is carried out, and they fabricate the taper section 2 of double taper steel wire, respectively, so that a roll spacing may become large by advance of rolling or it may become narrow.

[0020] Drawing, although the example of a four way roll is shown as a reduction roll, you may arrange to a tandem the horizontal and vertical two way roll with which the computer control of the roll spacing is carried out. Moreover, the number of roll stands may also arrange two or more to a tandem.

[0021] Hereafter, how to manufacture the strand of the double taper steel wire of this invention by the above-mentioned manufacturing installation is explained. After sending the material steel wire by which the wire drawing was carried out to the angle or the round-head cross section to the IH coil 6 and heating it, the hot rolling of it is carried out to a necessary variant cross section which is shown in drawing 3 by the reduction roll 7. At this time, while a roll spacing is changed by the computer control with a necessary cross-section configuration, rolling advances. That is, when rolling out the straight section 11 of drawing 1, a roll spacing is fixed uniformly and rolling advances. And while a roll spacing is narrowed in the position of the tapering taper section 13, rolling advances. Furthermore, a roll spacing is fixed again and it rolls out in the position which is rolled out while a roll spacing can extend in the position which rolls out the taper section 12 connected with the straight section 11, and rolls out the straight section 1. Strand S in which the straight section 1 which is shown in drawing 1, and the taper sections 2 and 3 exist by turns by this is fabricated.

[0022] The water cooled jacket immediately after rolling 8 quenches strand S by which hot rolling was carried out, and manipulation hardening is carried out from rolling temperature. Furthermore, it is heated by tempering temperature with the tempering IH coil 9, and is annealed. Then, it is cut in the position of 14 of drawing 1, and the steel wire for the coiled spring per piece is presented.

[0023] Thus, while the double taper steel wire of the variant cross section which has the taper section to ends can roll out easily according to this invention, this invention can perform variant cross-section molding and heat treatment of a quenching and tempering for what was performed at 2 of the forming cycle of a variant cross section, and the heat treatment process of a quenching and tempering processes at one process conventionally.

[0024] As explained above, since rapid short-time heating of the variant cross-section double taper spring steel line and its strand of this invention is carried out by IH etc., defects, such as decarbonization, do not produce them like other heating technique. moreover, rolling molding -- the variant cross section of the straight section, and an analog -- since the taper section of a cross section is fabricated continuously, it can mass-produce cheaply. Moreover, since ausform-hardening heat treatment is carried out at the same time it is made an anomaly a moulding pressure total, the heat-treated variant steel wire is obtained at one process, and a high intensity is obtained by the rapid heating and manipulation hardening. Furthermore, a quenching and tempering becomes possible continuously by preparing and annealing a

tempering IH coil behind a hardening cooling means at a tandem.

[0025] In addition, in this example, although rolling heating was depended on IH, also by direct energization heating, it is good and both may be used together. Moreover, in this example, although the four way roll was made into one stand, it is good as for two or more, and you may arrange a respectively horizontal and vertical two way roll to a tandem. Moreover, the cross-section configuration of a variant spring steel line can also be made into various configurations, such as rectangles other than the approximation trapezium of this example.

[0026]

[Effect of the Invention] Since the double taper spring steel line of the variant cross section which is not until now like according to the spring steel line of this invention described above is obtained, the property of a barrel shape and spindle shape coiled spring can be raised and lightweight-ized, and it can ** to the enhancement in a performance of spring parts.

Moreover, since the double taper spring steel line of the variant cross section heat-treated by the high intensity is obtained at one process according to the manufacture technique of this invention, the cost of a spring steel line can decrease sharply and the intended use of a barrel shape and spindle shape coiled spring spreads greatly.

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention is the spring steel wire coiled around a barrel shape or a spindle shape coiled spring configuration, and relates to the double taper spring steel line of a variant cross section by which a cross section has the tapering taper section in both the nose of cams side of the uniform straight section, and its manufacture technique.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, a double taper steel wire given [aforementioned] in JP,11-169991,A is indicated about the steel wire of a round-head cross section, and the double taper spring steel line of a variant cross section does not yet exist in a commercial scene today, either, being wished.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing an example of the strand of the variant cross-section double taper spring steel line of this invention.

[Drawing 2] It is the conceptual diagram showing the configuration of the whole manufacturing installation of the variant cross-section double taper spring steel line of this invention example.

[Drawing 3] It is drawing showing ***** of the configuration of the four way roll which rolls out the spring steel line of the approximation trapezium cross section of this invention example.

[Drawing 4] It is drawing showing the configuration of spindle shape coiled spring.

[Description of Notations]

1 Vertical Level Roll, 2 Right-and-Left Vertical Roll, 5 Computer, 6 Rolling Heating Coil, 7 Reduction Roll, 8 Water Cooled Jacket (Hardening Cooling Means), 9 Tempering Heating Coil, 11 Straight Section, 12, 13 Taper Section, 14 Disconnection Section, 15 Coil Drum Section, 16 Coil Minor-Diameter Section, S Steel Wire

[Translation done.]

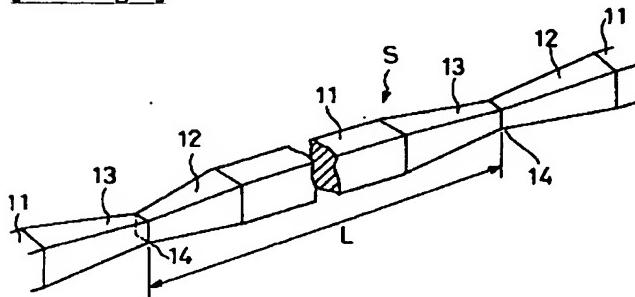
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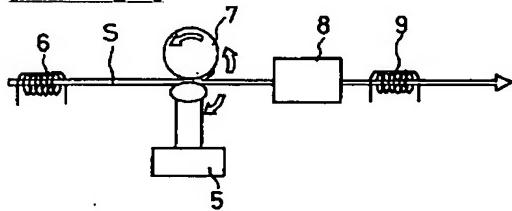
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DRAWINGS

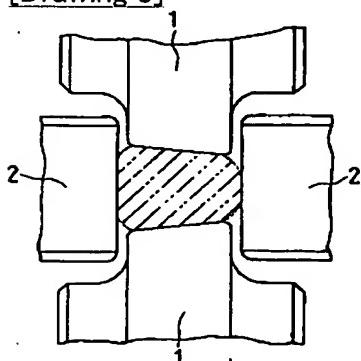
[Drawing 1]



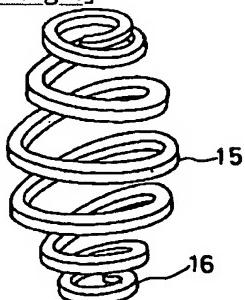
[Drawing 2]



[Drawing 3]



[Drawing 4]



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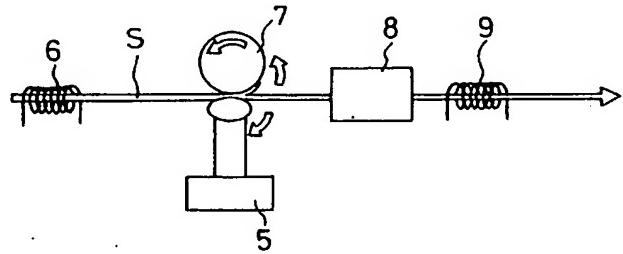
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(54)【発明の名称】 異形断面ダブルテーパーばね鋼線とその製造方法

(57)【要約】

【課題】 異形断面のストレート部の両端側にほぼ相似
断面の先細りのテーパ部を有する異形断面ダブルテーパー
ばね鋼線。

【解決手段】 ロール間隔が制御される圧延ロールによ
り、異形断面のストレート部11とほぼ相似異形断面の
テーパ部12、13が長さ方向に交互に存する素線Sを
圧延し、異形断面のストレート部の両端側にほぼ相似異
形断面の先細りのテーパ部を有する異形断面ダブルテーパー
ばね鋼線を得る。



【特許請求の範囲】

【請求項1】 異形断面のストレート部の両端側に該ストレート部とほぼ相似断面の先細りのテーパ部を有することを特徴とする異形断面ダブルテーパばね鋼線。

【請求項2】 異形断面のストレート部と該ストレート部とほぼ相似断面のテーパ部とが長さ方向に交互に存する素線であることを特徴とする異形断面ダブルテーパばね鋼線用素線。

【請求項3】 誘導加熱または／および直接通電加熱手段により被加工鋼線を圧延温度まで加熱し、熱間成形により所定異形断面のストレート部とその両端側の該ストレート部とほぼ相似断面の先細りのテーパ部とを成形することを特徴とする異形断面ダブルテーパばね鋼線の製造方法。

【請求項4】 誘導加熱または／および直接通電加熱手段により被加工鋼線を圧延温度まで加熱し、熱間成形により所定異形断面のストレート部と該ストレート部とほぼ相似断面のテーパ部とが交互に存する素線を成形することを特徴とする異形断面ダブルテーパばね鋼線素線の製造方法。

【請求項5】 前記異形断面の熱間成形は、所要断面にしたがって対向ロール間隔が制御される圧延ロールにより圧延されることを特徴とする請求項3または4に記載の異形断面ダブルテーパばね鋼線またはその素線の製造方法。

【請求項6】 前記異形断面ダブルテーパばね鋼線は、方形または近似梯形断面であることを特徴とする請求項5に記載の異形断面ダブルテーパばね鋼線またはその素線の製造方法。

【請求項7】 前記熱間成形直後に急冷して加工焼入れを行うことを特徴とする請求項3から6のいずれかに記載の異形断面ダブルテーパばね鋼線またはその素線の製造方法。

【請求項8】 前記加工焼入れ後に連続して、誘導加熱により焼戻しすることを特徴とする請求項7に記載の異形断面ダブルテーパばね鋼線またはその素線の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、例えば樽形あるいは紡錘形コイルばね形状に巻かれるばね用鋼線で、断面が均一のストレート部の両先端側に先細りのテーパ部を有する異形断面のダブルテーパばね鋼線及びその製造方法に関するものである。

【0002】

【従来の技術】通常のコイルばねは全長が同一径の素線を巻いて成形されているが、樽形あるいは紡錘形コイルばねの場合には、図5に示すようにばねのコイル胴部15の素線径よりばね端部側のコイル小径部16の素線径を小さくすること望ましい。こうすると、全部同一径素

線の樽形ばねに比して特別なばね特性を得ることができ、かつ重量軽減ができるという利点がある。そのためには、ばね用鋼線として両端に先細りのテーパ部を有するダブルテーパ鋼線を使用することが望まれる。

【0003】一方、通常のコイルばねの軽量化とばね特性の向上のために、丸断面でなく異形断面のばね鋼線が使用されているが、樽形あるいは紡錘形コイルばねの場合も異形断面ばね鋼線の使用が望まれている。このために、異形断面のダブルテーパばね鋼線が要求されている。

【0004】このようなダブルテーパばね鋼線の製造方法については、出願人が先に特開平11-169991号公報において丸断面のダブルテーパばね鋼線について開示した技術がある。

【0005】

【発明が解決しようとする課題】しかしながら、前記特開平11-169991号公報記載のダブルテーパ鋼線は、丸断面の鋼線について開示されたものであり、異形断面のダブルテーパばね鋼線は望まれていながら今日まだ市場にも存在しない。

【0006】また、従来の異形断面ばね鋼線は、丸断面の圧延鋼材を異形断面に伸線する伸線工程と、その後にオイルテンパなどの方法で焼入焼戻しする熱処理工程の2工程で製造された。そのため、工程が多く工数が増してコスト低減が困難であるという問題点があった。

【0007】そこで本発明は、上記問題点を解決し、異形断面のダブルテーパばね鋼線と、その安価な製造方法を提供することを目的とする。

【0008】

【課題を解決するための手段】上記目的を達成するため、本発明の異形断面ダブルテーパばね鋼線は、異形断面のストレート部の両端側に該ストレート部とほぼ相似断面の先細りのテーパ部を有することを特徴とするものである。

【0009】また、本発明の異形断面ダブルテーパばね鋼線用の素線は、異形断面のストレート部と該ストレート部とほぼ相似断面のテーパ部が長さ方向に交互に存する素線であることを特徴とするものである。このようなストレート部とテーパ部が交互に存する素線を適宜に切断することにより、前記のストレート部の両端に先細りのテーパ部を有する異形断面ダブルテーパばね鋼線の量産が容易にできる。

【0010】本発明の異形断面ダブルテーパばね鋼線及び素線の製造方法は、誘導加熱または／および直接通電加熱手段により被加工鋼線を圧延温度まで加熱し、熱間成形により所定異形断面のストレート部とその両端側の該ストレート部とほぼ相似断面の先細りのテーパ部とを成形するか、あるいは熱間成形により所定異形断面のストレート部と該ストレート部とほぼ相似断面のテーパ部とが交互に存する素線を成形することを特徴とするもの

である。

【0011】前記異形断面の熱間成形は、所要断面にしたがって対向ロール間隔が制御される圧延ロールにより圧延されることが簡易に目的を達成するために望ましい。

【0012】すなわち、対向ロールの間隔が圧延の進行に伴って、コンピュータにより開いたり狭まつたり制御される圧延ロールを用いて、ストレート部はロール間隔を一定にして圧延し、テーパ部はロール間隔を狭めながら、あるいは広げながら圧延を進行させることによりテーパを成形するものである。この圧延ロールは、圧延形状により2方ロールでも、あるいは3方または4方ロールの多方ロールでもよく、ロールスタンド数も1スタンドあるいは複数のスタンドをタンデムに配列してもよい。

【0013】この異形断面ダブルテーパばね鋼線は、方形または近似梯形断面に適するが、ここでいう異形断面とは正方形、長方形、多角形、梢円など円以外の形状を含むものである。またテーパ部のほぼ相似断面とは、ストレート部と完全相似のみでなく、ストレート部と連続的につながる近似断面を含むものをいう。

【0014】また、前記熱間成形直後に急冷して加工焼入れを行うことにより、異形断面の成形と焼入熱処理が1工程で可能になる。この加工焼入れは前記圧延ロールに近接してタンデムに配設された焼入冷却手段により行うようにすれば、圧延温度からの急冷が均一になり、高い焼入硬さが容易に得られる。かつ、誘導加熱などによって急速短時間加熱することにより、通常の炉加熱より脱炭などの欠陥が少なく、かつ高い加工焼入れの効果が得られる。

【0015】さらに、前記加工焼入れ後に連続して誘導加熱により焼戻しすることにより、異形断面の成形、焼入焼戻しが連続工程でできる。この焼戻しは、前記焼入冷却手段の後方にタンデムに配設された焼戻誘導加熱コイルにより、連続的に行なうことが望ましい。

【0016】

【発明の実施の形態】以下、本発明を図示の1実施形態について具体的に説明する。図1は本発明実施例の異形断面ダブルテーパばね鋼線と素線（以下単にダブルテーパ鋼線という）の一例を示す図、図2は本発明実施例のダブルテーパ鋼線の製造装置の全体の構成を示す概念図、図3は近似梯形断面のばね鋼線を圧延する4方ロールの一例を示す図である。

【0017】図1に示すように、本発明のダブルテーパ鋼線Sは、異形断面の断面寸法が同一のストレート部1の両端側にほぼ近似断面形状の先細りのテーパ部12、13が設けられた長さLの形状をなすものである。これを1こづつ単独で成形しても良いが、図1に示すようにストレート部11とテーパ部12、13が交互に形成された素線を成形し、最小径の位置14で切断するこ

とにより長さLのダブルテーパ鋼線Sの量産が容易になる。

【0018】図2の製造装置について説明すると、上流側から誘導加熱コイル6、圧延ロール7、水冷ジャケット（焼入冷却手段）8、及び焼戻誘導加熱コイル9がタンデムに配列されている。

【0019】圧延される断面形状は、正方形、長方形の他、図3に示すような近似梯形断面などが成形される。図3は近似梯形断面の鋼線を圧延する4方ロールの形状を示すものであるが、上下1対の水平ロール1、1により梯形の側面を成形し、左右1対の垂直ロール2、2により梯形の頂底面を成形するようにされている。水平ロール1、1と垂直ロール2、2は、それぞれコンピュータ5により、圧延の進行によりロール間隔が広くなったり狭くなったりするように駆動制御されてダブルテーパ鋼線のテーパ部2を成形するようになっている。

【0020】図では、圧延ロールとして4方ロールの例が示されているが、ロール間隔がコンピュータ制御される水平、垂直の2方ロールをタンデムに配列しても良い。また、ロールスタンド数も2以上をタンデムに配列しても良い。

【0021】以下、上記製造装置により本発明のダブルテーパ鋼線の素線を製造する方法について説明する。角または丸断面に伸線された素材鋼線は、誘導加熱コイル6に送られて加熱された後、圧延ロール7により例えば図3に示すような所要の異形断面に熱間圧延される。このとき、所要断面形状によってロール間隔が、コンピュータ制御により変えられながら圧延が進行する。すなわち、図1のストレート部11を圧延するときはロール間隔が一定に固定されて圧延が進行される。そして先細りのテーパ部13の位置でロール間隔が狭められながら圧延が進行する。さらに、ストレート部11につながるテーパ部12を圧延する位置でロール間隔が広げられながら圧延され、ストレート部11を圧延する位置で再びロール間隔が固定されて圧延される。これにより、図1に示すようなストレート部11とテーパ部12、13が交互に存在する素線Sが成形される。

【0022】熱間圧延された素線Sは、圧延直後水冷ジャケット8により急冷されて圧延温度から加工焼入れされる。さらに、焼戻誘導加熱コイル9により焼戻し温度に加熱されて焼戻しされる。その後、図1の14の位置で切断されて、1個づつのコイルばね用の鋼線に供せられる。

【0023】このように本発明によれば、両端にテーパ部を有する異形断面のダブルテーパ鋼線が容易に圧延できるとともに、従来は異形断面の成形工程と焼入焼戻しの熱処理工程の2工程で行われたものを、本発明では異形断面成形と焼入焼戻しの熱処理を1工程で行なうことができる。

【0024】以上説明したように本発明の異形断面ダブ

ルテーパばね鋼線とその素線は、誘導加熱などにより急速短時間加熱されるので、他の加熱方法のように脱炭などの欠陥が生じない。また、圧延成形により、ストレート部の異形断面と相似形断面のテーパ部が連続して成形されるので安価に量産が可能である。また、異形に成形圧延されると同時に加工焼入熱処理されるので、熱処理された異形鋼線が1工程で得られ、急速加熱、加工焼入れにより高い強度が得られる。さらに、焼入冷却手段の後方に、焼戻し誘導加熱コイルをタンデムに設けて焼戻しすることにより、連続的に焼入焼戻しが可能になる。

【0025】なお本実施例においては、圧延加熱を誘導加熱によったが直接通電加熱によってもよいし、両者を併用してもよい。また、本実施例では4方ロールを1スタンドとしたが2以上にしてもよく、それぞれ水平、垂直の2方ロールをタンデムに配列しても良い。また、異形ばね鋼線の断面形状は本実施例の近似梯形以外の方形など種々の形状とすることもできる。

【0026】

【発明の効果】以上述べたように、本発明のばね鋼線によれば、今までにない異形断面のダブルテーパばね鋼線が得られるので、樽形、紡錘形コイルばねの特性を上げ

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軽量化することができ、ばね部品の性能向上に資することができる。また、本発明の製造方法によれば、高い強度に熱処理された異形断面のダブルテーパばね鋼線が一工程で得られるので、ばね鋼線のコストが大幅に低減でき、樽形、紡錘形コイルばねの用途が大きく広がる。

【図面の簡単な説明】

【図1】本発明の異形断面ダブルテーパばね鋼線の素線の一例を示す図である。

【図2】本発明実施例の異形断面ダブルテーパばね鋼線の製造装置の全体の構成を示す概念図である。

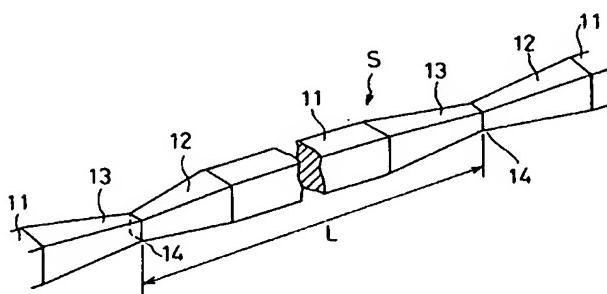
【図3】本発明実施例の近似梯形断面のばね鋼線を圧延する4方ロールの形状の一例を示す図である。

【図4】紡錘形コイルばねの形状を示す図である。

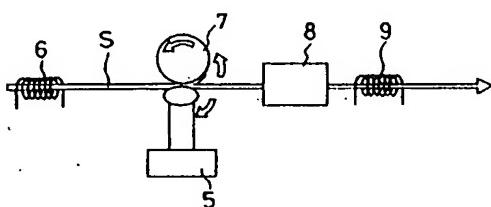
【符号の説明】

1 上下水平ロール、2 左右垂直ロール、5 コンピュータ、6 圧延加熱コイル、7 圧延ロール、8 水冷ジャケット（焼入冷却手段）、9 焼戻し加熱コイル、
11 ストレート部、12、13 テーパ部、14 切断部、15 コイル胴部、16 コイル小径部、S 鋼線

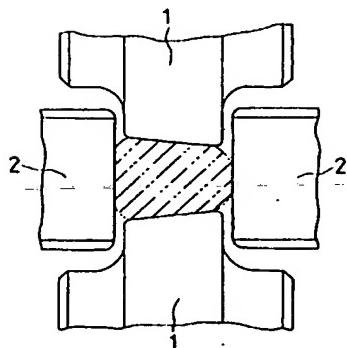
【図1】



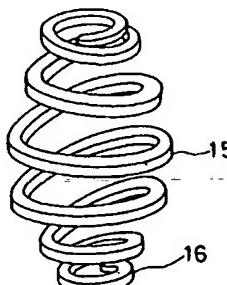
【図2】



【図3】



【図4】



フロントページの続き

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